Dynamic Bank Capital Regulation in Equilibrium

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Motivation

- The debate on macroprudential regulation moves from the assumption that many banks had inadequate levels of capital prior to the 2007-08 crisis.
- While the need of capital adequacy regulation is uncontroversial, there is still a lack of agreement about the **cost** of bank capital and **how much** bank capital is required, which are interrelated issues.
- To address these points, some have assimilated bank debt to corporate liabilities and adopted a MM framework.
- However, this would miss the role of **money** played by deposits.

Our plan

- We analyze bank capital regulation in a GE setup, in which **bank debt provides liquidity**
  - deposits will be endogenously less expensive than bank equity;
  - bankers' leverage decisions reflect investors **preferences for liquidity**, which are driven by **aggregate uncertainty**;
  - because the prices of bank securities depend on accumulated wealth, we endogenize the current state in a **dynamic model**.
- Regulation is motivated by the fact that bank failures impose a **negative externality** on the economy.
  - We benchmark regulation against the **constrained efficient** allocation attainable by a social planner.
  - We model a **boundedly rational regulator**, who restricts leverage to **approximate** the efficient policy, everything else being determined in a **decentralized equilibrium**.

What we find

- Constrained efficiency entails strong **procyclicality** of banking sector leverage.
- Compared to the laissez faire economy the efficient policy is "**countercyclical**," because it restricts leverage in upturns.
- A **state-contingent** bank capital regulation that allows for procyclicality approximates well the constrained first best.
- Dynamic welfare effects are very sensitive to the **tightness** of the leverage restiction.
- Deposits are indeed **less expensive** than equity in equilibrium,
  - the return wedge between equity and debt reflects the social costs of inefficient bank capital regulation.

Model

- Discrete time, infinite horizon.
- Consumers, producers, bankers.
- Two goods:
  - a perishable consumption good
  - a durable capital good, which depreciates at γ.
- Producers produce capital goods investing consumption goods ($\varphi(I)$, with decreasing returns to scale).
  - production maximizes NPV, which is paid to consumers.
- Bankers control capital goods (k) purchased from consumers issuing fairly priced deposits (q) and equity (r).
- Banks' linear technology is subject to idiosyncratic (θ, iid) and aggregate (A, MC) shocks and produces consumption goods.
- Consumers manage a portfolio of deposits and equity to fund consumption (c) to maximize lifetime utility (u).

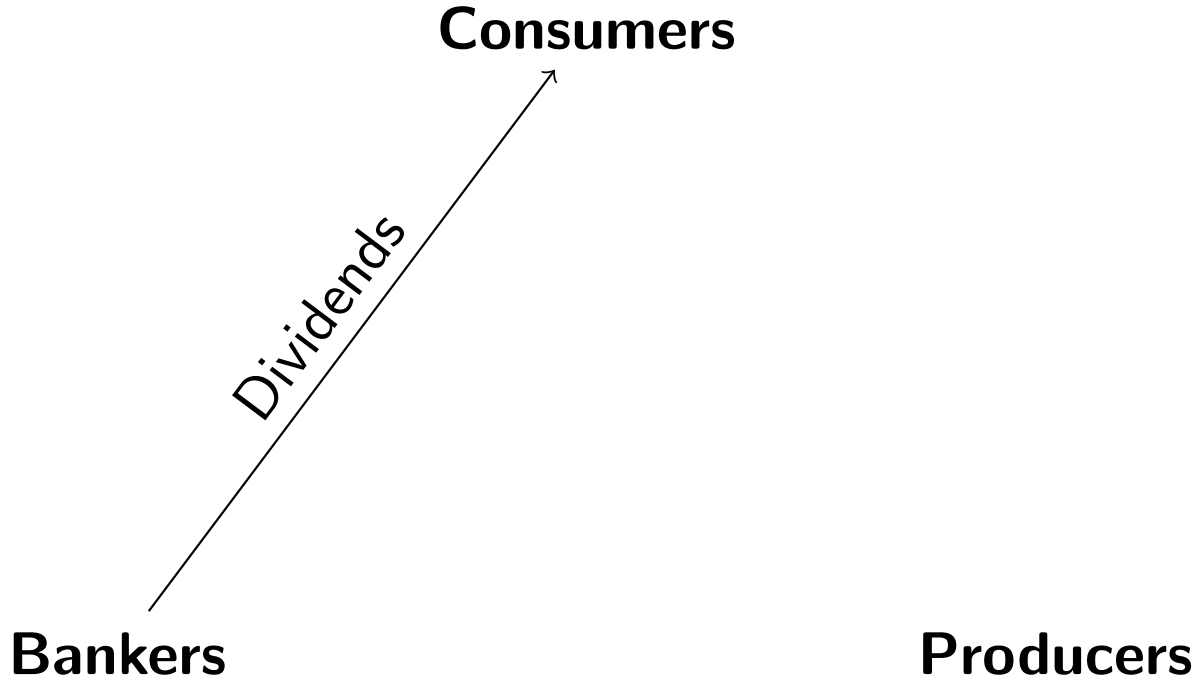
Model (continued)

- Deposits are necessary for consumption, which can only occur in the morning.
  - This segmentation makes deposits a cheaper source of funding.
- Bank's default results in loss of a fraction (δ) of revenues.
- Bank's capital structure is determined by a tradeoff between
  - the funding advantage of debt,
  - the risk of costly default.
- Security markets are incomplete because only debt and equity can be traded and default risk cannot be diversified.
- Bankers choose capital structure (amount of deposits, z, per unit of capital good) to maximize the value of their bank.
- Security prices depend on leverage. Bankers use marginal utilities of representative consumer to value securities.

Timeline

In the afternoon of period t

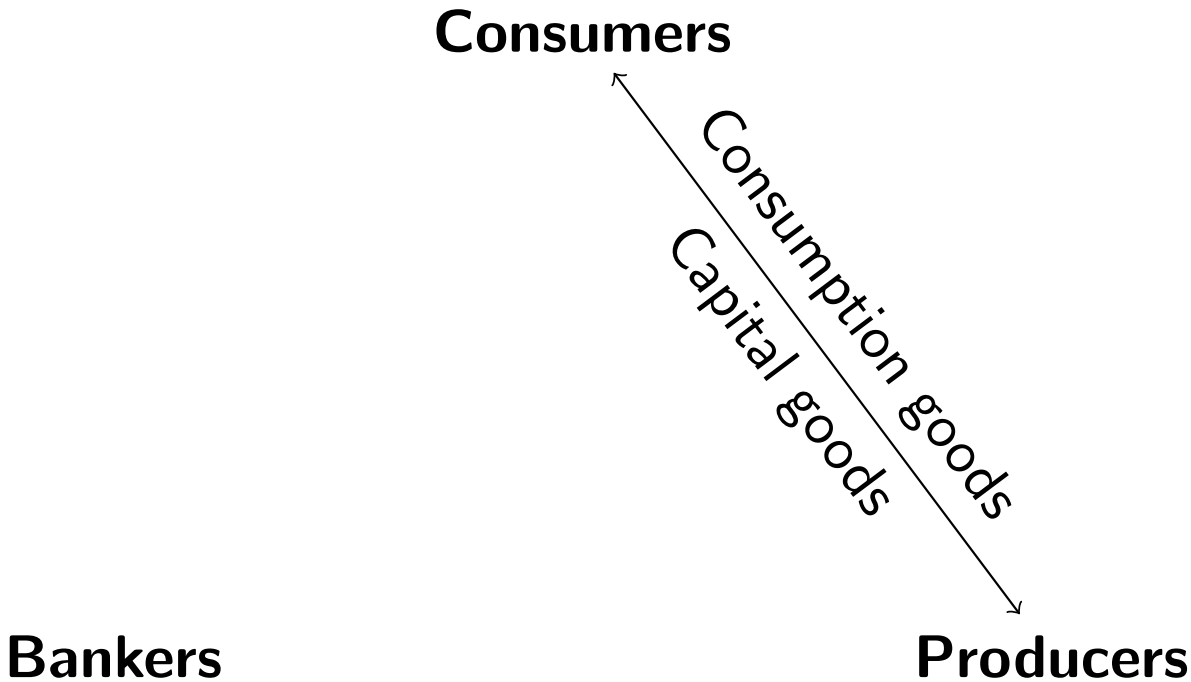
Solvent banks pay dividends to consumers and insolvent banks settle their debt



Timeline

In the afternoon of period t

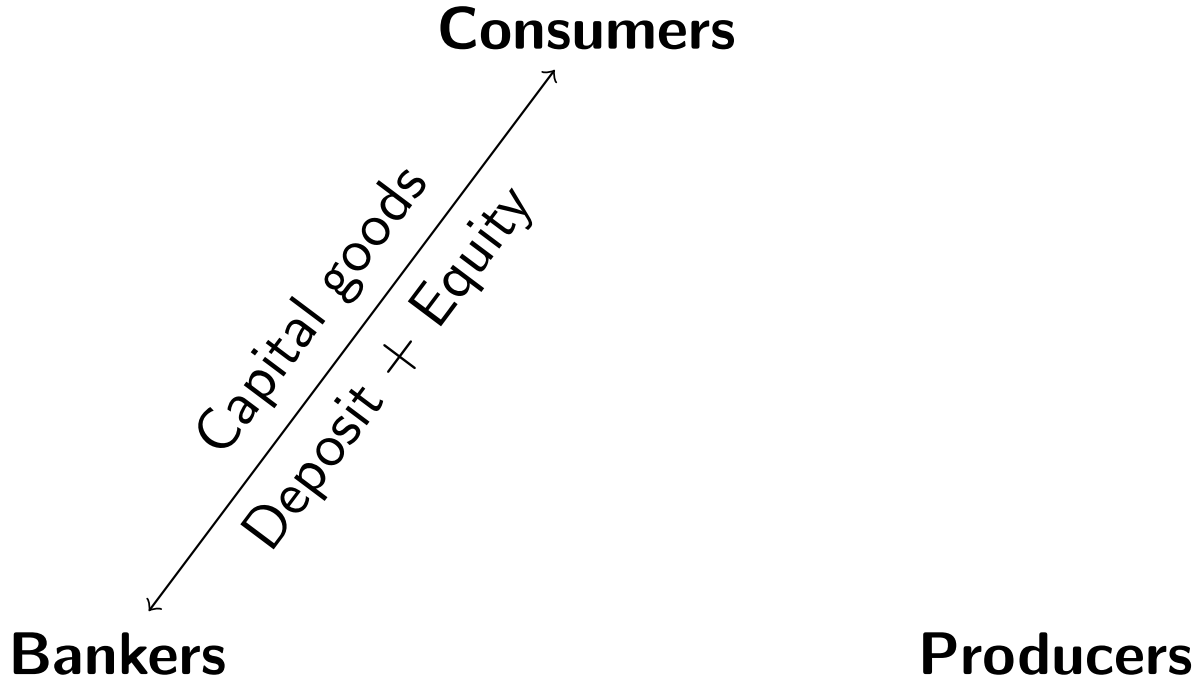
Consumers give consumption goods to producers, who immediately produce and return capital goods



Timeline

In the afternoon of period t

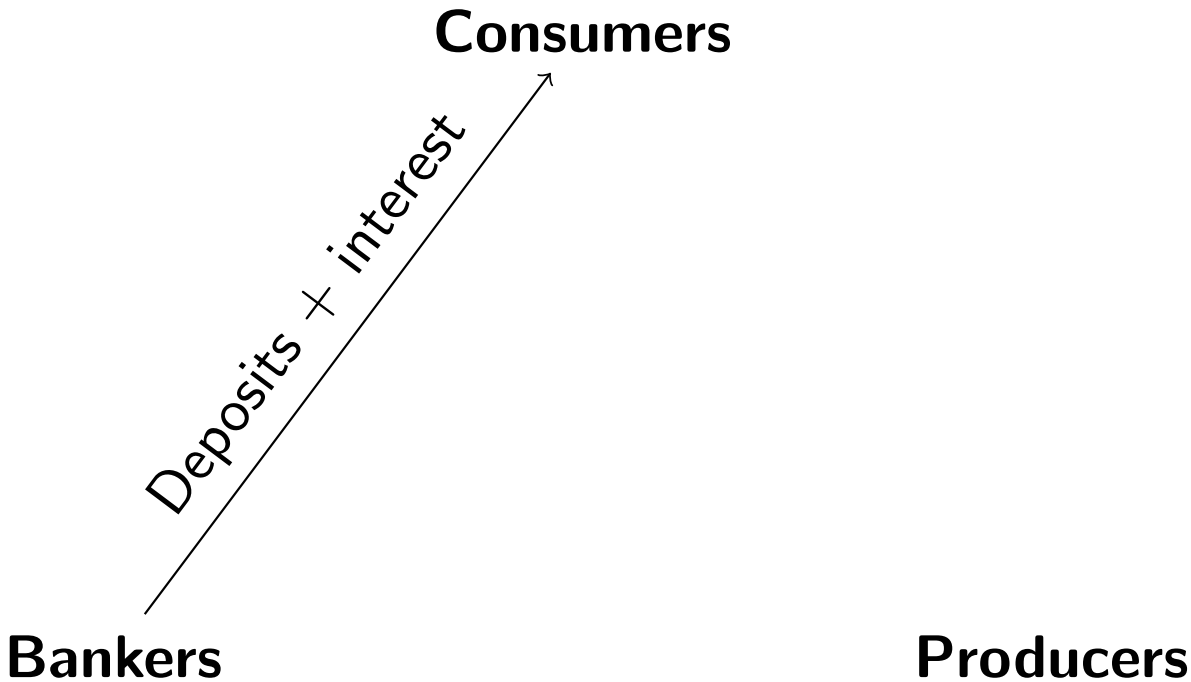
Capital goods are sold to bankers. To fund the purchase, they issue securities



Timeline

In the morning of period $t+1$

(A', θ') is known, and bankers' cash flow are realized and, if bank is solvent, deposits are drawn and consumed



Constrained efficiency

Absent the negative externality of bank's leverage, the decentralized equilibrium is the solution to a planner's problem:

$$V(k,A) = \max_{(\mathbf{c},\mathbf{I},\mathbf{k},z)} \sum_{A' \in \mathcal{A}} \beta \left\{ u\left(c\left(A'\right)\right) + V\left(k\left(A'\right), A'\right) \right\} p\left(A'|A\right)$$

subject to the constraints: $(\mathbf{c},\mathbf{I},\mathbf{k},z) \geq \mathbf{0}$,

$$c\left(A'\right) \leq k\left[A' \int_0^{\frac{z}{A'}} (1-\delta)\,\theta dF + z\left(1 - F\left(\frac{z}{A'}\right)\right)\right], \text{ for any } A' \in \mathcal{A}$$

$$I\left(A'\right) = A'k \int \theta dF - A'k \int^{\frac{z}{A'}} \delta\theta dF - c\left(A'\right), \text{ for any } A' \in \mathcal{A}$$

$$k\left(A'\right) = (1-\gamma)\,k + \varphi\left(I\left(A'\right)\right), \text{ for any } A' \in \mathcal{A}.$$

Given equilibrium, we find prices (q,r) so that consumers, bankers and producers solve their respective optimization problems.

Regulated equilibrium

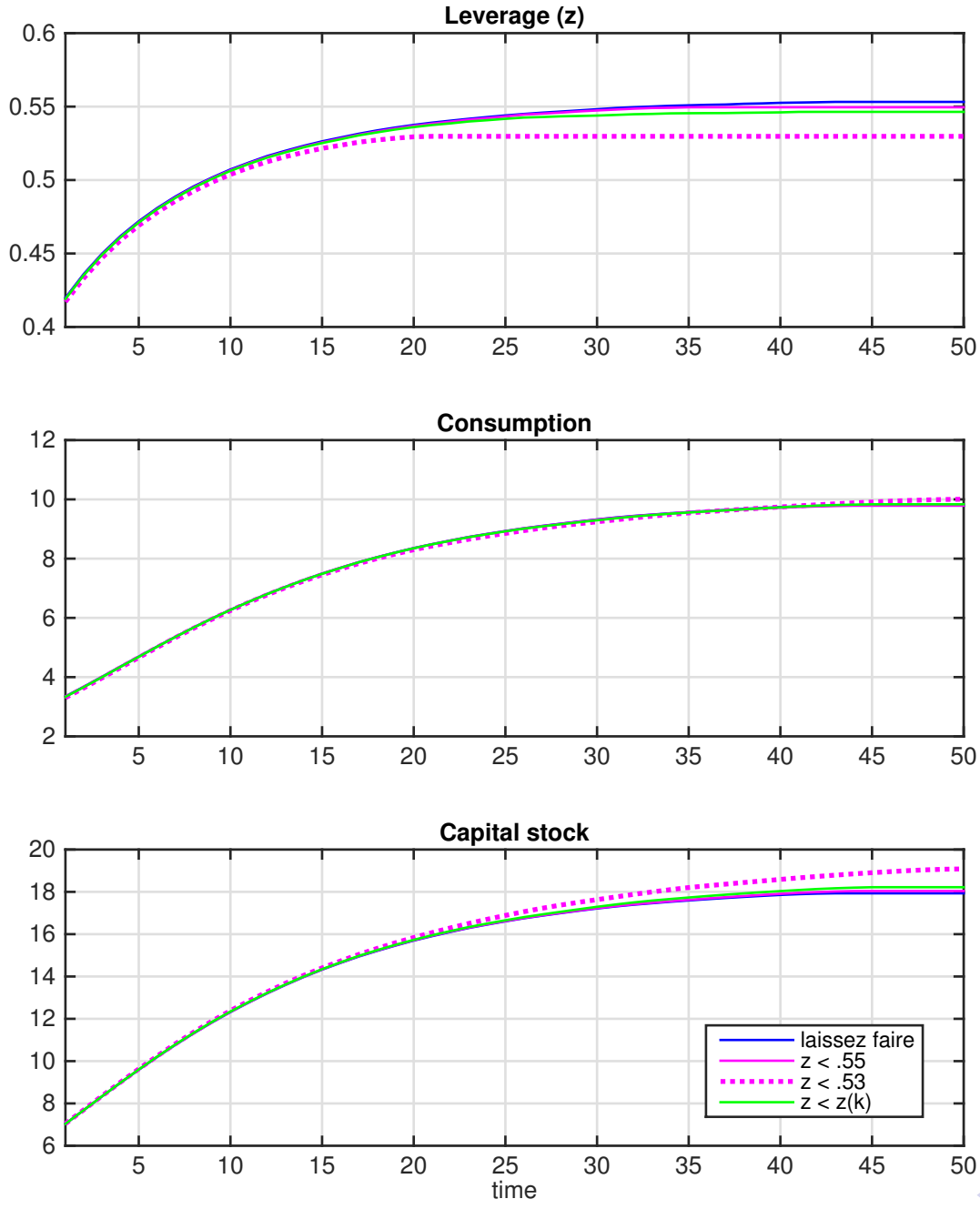
- The motivation for bank regulation is a negative externality generated by the leverage in the banking sector:

$$u(c) - \xi z k, \qquad \xi > 0.$$

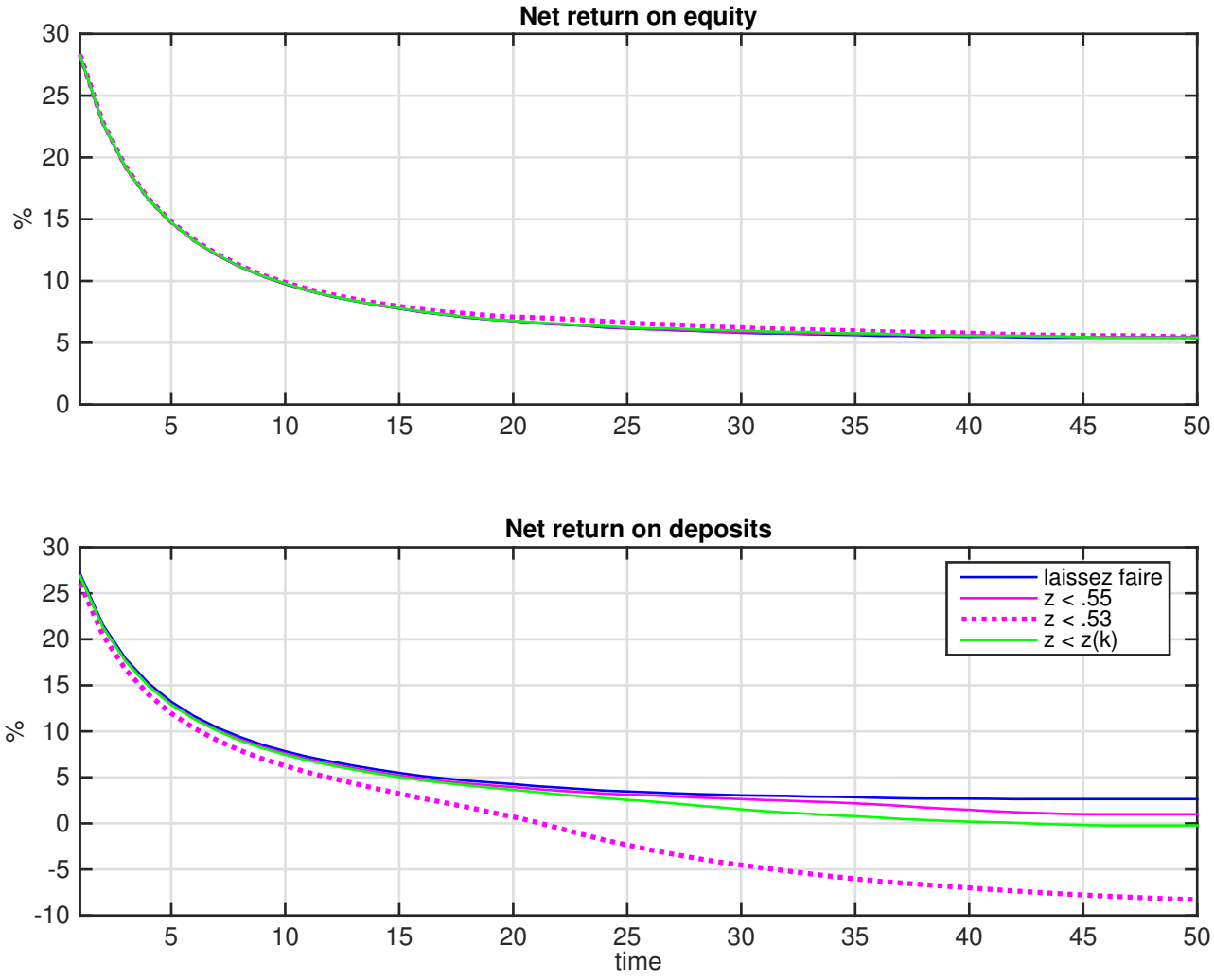
- Therefore, it affects the consumer's welfare but not the decisions of the consumers, bankers, and producers:
  - equilibrium calculated using the planner's recursive program.

- Regulator imposes an upper bound on leverage ($\bar{z}$, $\bar{z}(A)$, or $\bar{z}(k, A)$), while competitive equilibrium determines the rest:
  - equilibrium is the solution of a "planner"'s problem under $z \leq \bar{z}(k, A)$, assuming the "planner" ignores the externality;
  - the solution is then decentralized finding prices (q, r) which support the optimal decisions of the agents.

Effect of regulation on policies (no aggregate shock)



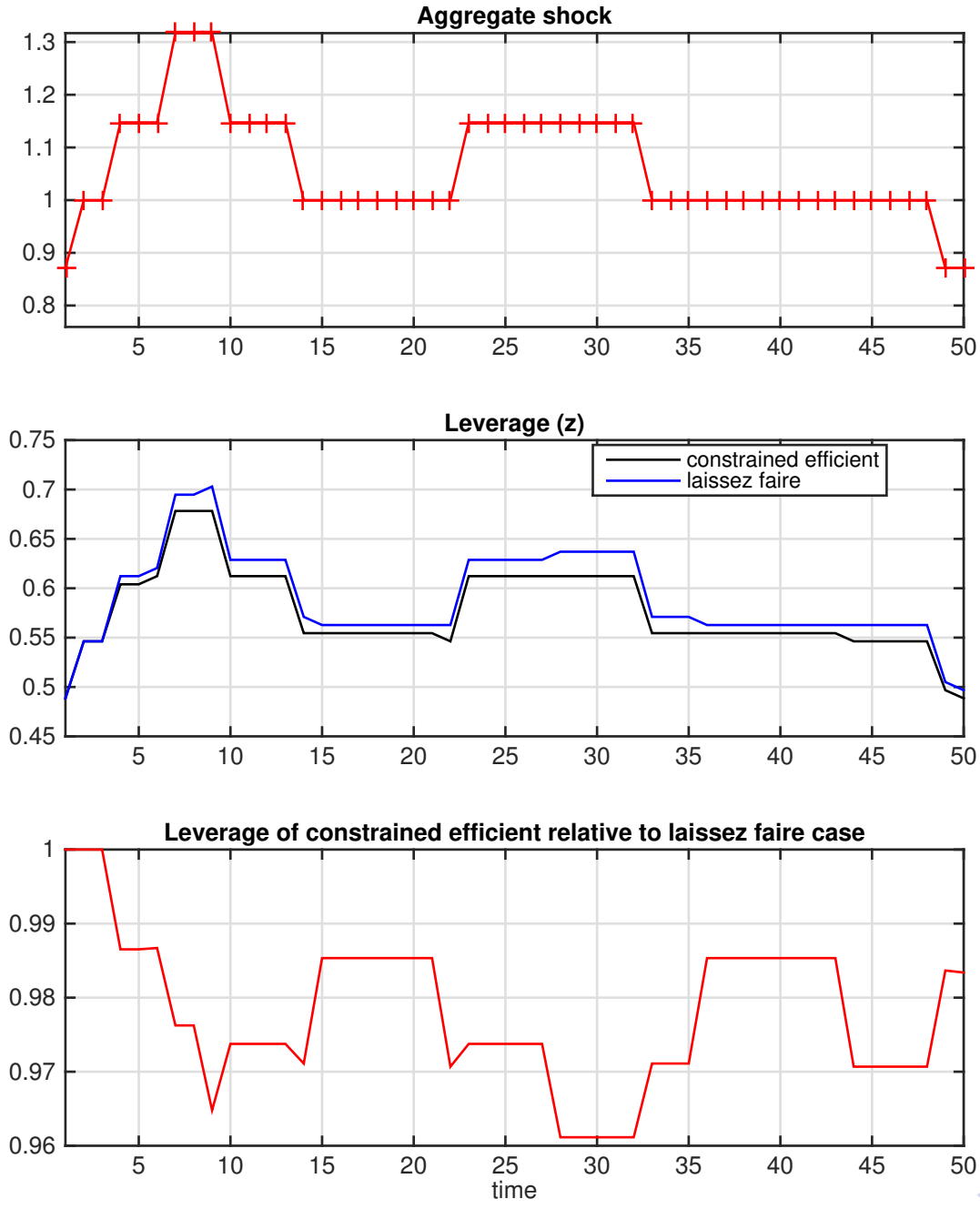
Effect of regulation on returns (no aggregate shock)



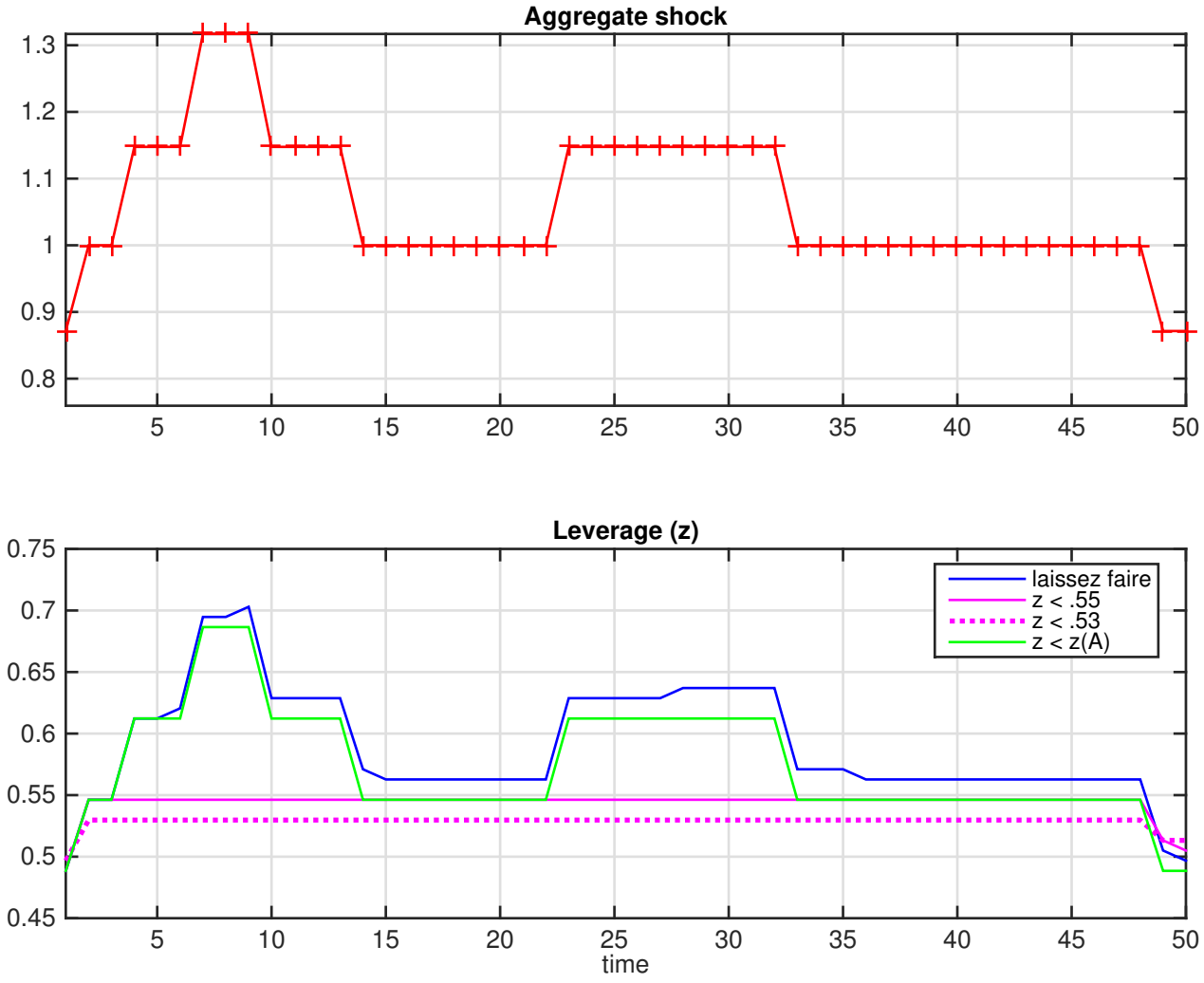
Salient points I

- Small changes in the maximum leverage can have large effects in the long run.
- Consumption does not differ much between $\bar{z} = 0.55$ and $\bar{z} = 0.53$. However, a tighter constraint leads to an inefficiently higher investment and capital stock.
- The excess capital accumulation is inefficient because
  - consumption is lower along the transition to the steady state;
  - higher capital requires more resources are invested to offset depreciation.
- The tighter the leverage constraint, the lower the return on deposits.

Constrained efficient leverage dynamics



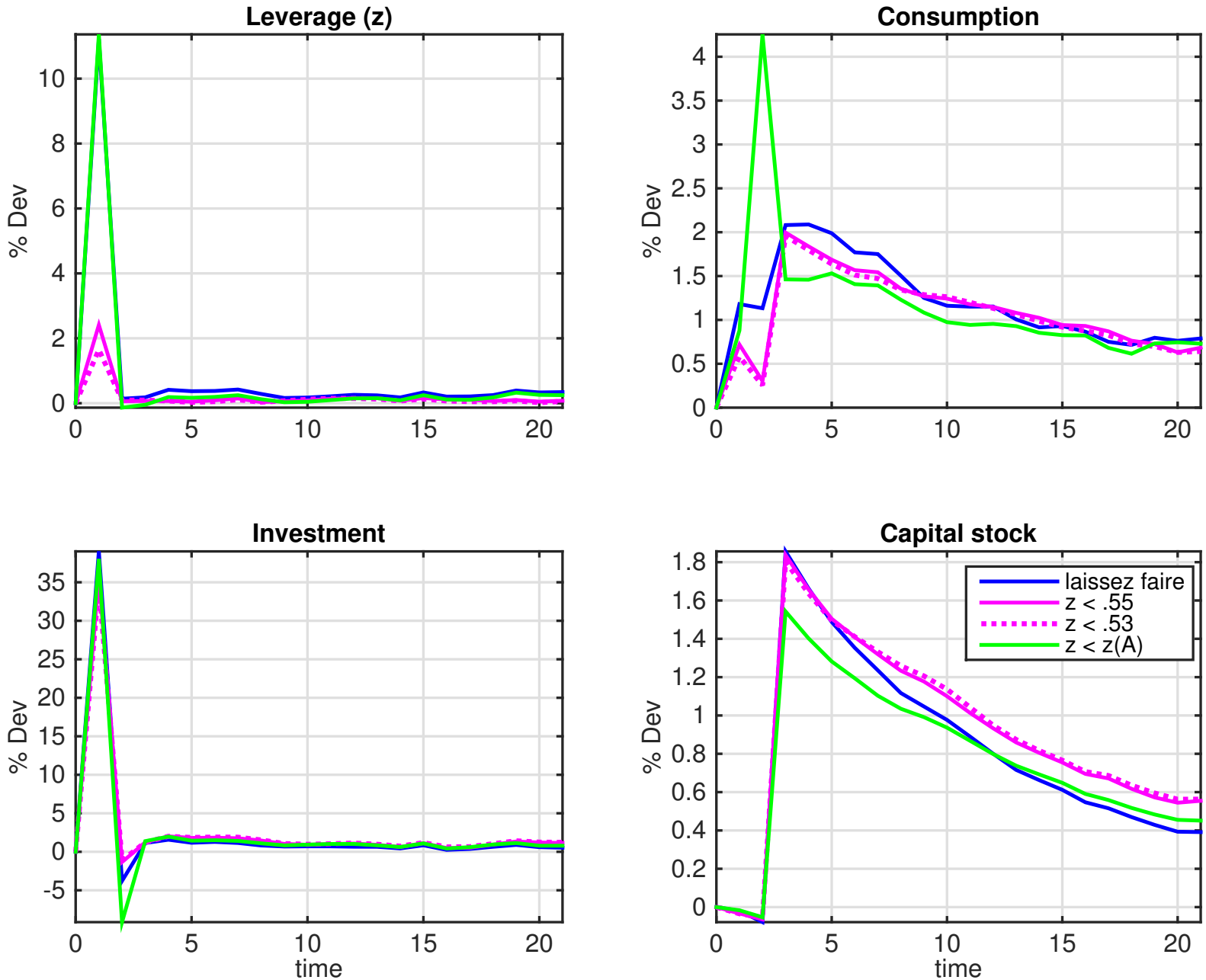
Regulated leverage dynamics



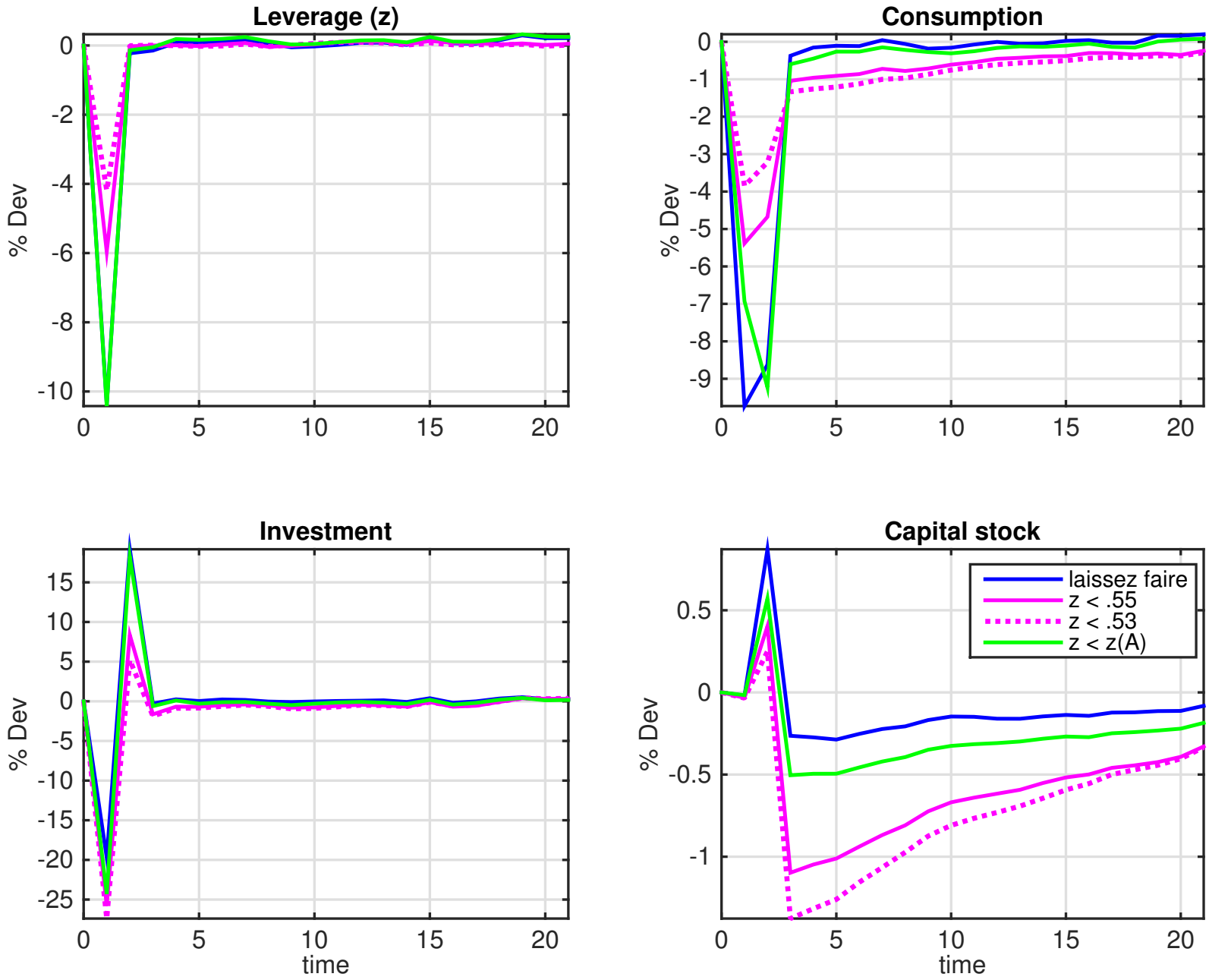
Salient points II

- Leverage is procyclical in the sense that an increase in productivity (A) leads to an increase in leverage (z).
- The constrained efficient policy is "countercyclical:"
  - the constrained efficient leverage is proportionately smaller compared to the laissez faire leverage when A is high, than it is in when A is low.
- A state-dependent leverage constraint may be a good approximation to the constrained efficient policy.
- The inefficiency of a constant (non-contingent) leverage constraint stems from the restriction imposed during upturns.

Impulse responses to an upward shock on A



Impulse responses to a downward shock on A



Salient points III

- Because leverage (z) is predetermined, a productivity shock has asymmetric effects depending on whether the productivity A' is high or low:
  - if A' is high, consumption is constrained by z;
  - if A' is low, consumption is effectively unconstrained.
- The impact of a shock on A' is mainly absorbed by changes in investment.
- A constant capital regulation restricts:
  - consumption in economic upturns;
  - investment in economic downturns.

Main take-away points

- The constrained efficient leverage policy is procyclical (but countercyclical relative to laissez faire).
- A state-dependent leverage constraint achieves a near efficient allocation.
- A tight and constant leverage contraint is inefficient because it forces high investments (and therefore higher depreciation) and reduces the return on deposits.
- A constant leverage constraint inefficiently restricts:
  - consumption and leverage in upturns;
  - investment in economic downturns.